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SAAB SONICS

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(Photo: E. Lundqvist)

On the right: Unconventional view of the Saab Scandia
(Photo: A. Svenberger)

Classification summary for the technical articles is to be found on the third page of the cover

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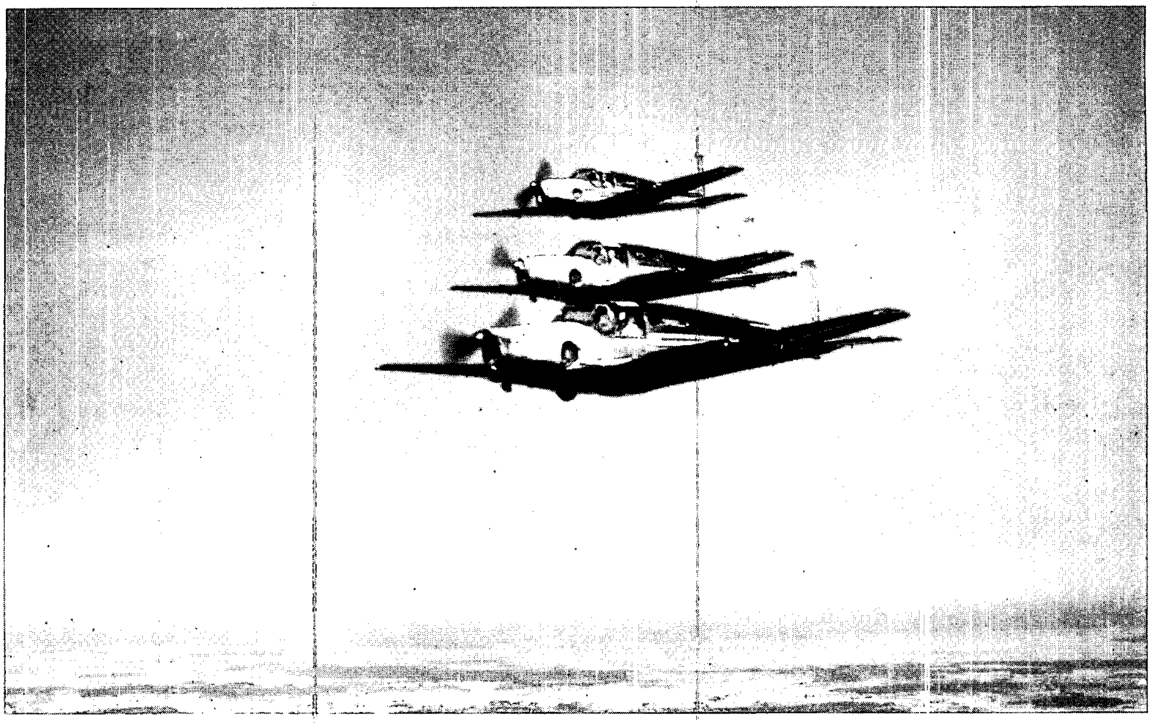


Three Saab Safirs are flown to India for delivery

Saab Safir — the Gem of the Air

by

Arne Krabbe, Saab's Public Relations Manager

Safir — the gem of the air — is a proud attribute, a name involving obligations and one to which the glittering little machine is fully entitled.

Work on the design was commenced in 1944 and in 1945 the Safir was flown for the first time. With three years of existence behind it, it is still in the youthful stage but notwithstanding this fact a considerable advance can be claimed on its behalf and it is already responsible for a notable chapter in the history of flight.

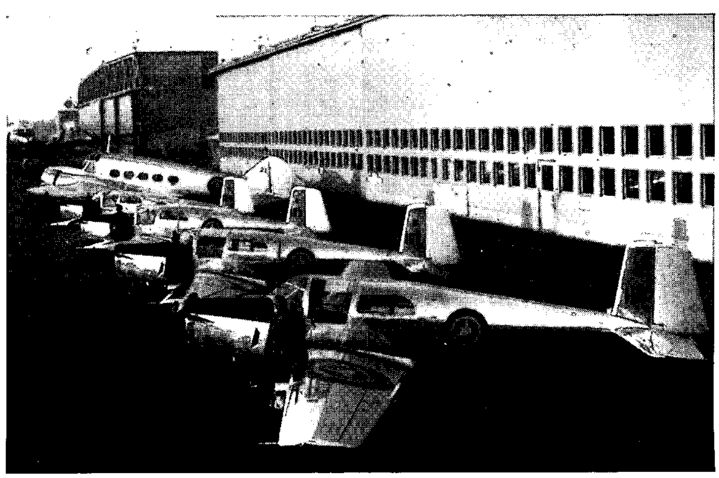
The Royal Swedish Air Force has purchased a number of Safirs for use as staff- and liaison planes, in which service the machine has met with the highest appreciation. However also private aviators in Sweden began to interest themselves in the plane and very soon discovered that the Safir is the ideal machine for sporting and business purposes. The first private flyers to purchase Safirs were Mr. Uno Ranch and Mr. Gösta Fraenckel, both of whom became Safir enthusiasts of the first rank. Mr.

Mr. Arne Krabbe

Ranch moreover caracterises his first encounter with the Safir as "love at first sight" and "a love that is never betrayed". Mr. Ranch and Mr. Fraenckel have both toured round Sweden in their Safirs since 1946, but their flight log-books also include trips to the Continent of Europe, primarily England. At the present day the Safir can be found in many parts of Sweden and thanks to the A.B. Centralflyg which employs the plane for taxi flights and circular tours, the machine has now visited most places in the country. The interest displayed in Europe for the plane has been considerable. The machine delivered to Mr. Michael Christie in London has been tested by English experts and the test pilot, Maurice A. Smith, has expressed his impressions concerning it in an article published in "Flight" of the 23rd October 1947. His report was of such a favourable nature that Saab's sales department is now glad to enclose copies of it with their quotations.

As early as the end of 1946 however, a beginning was made with the exportation of the Safir to countries beyond the boundaries of Europe. Ethiopia was the first customer and the plane purchased by the Duke of Harrar was flown on delivery to Addis Ababa by Saab's chief test pilot, Captain Claes J. Smith. The impression made on the Ethiopians by the Safir was so favourable that a division of Safirs was flown to that country in 1946 to be incorporated in the Imperial Ethiopian Air Force as school- and training planes. Deliveries to Ethiopia reached their height when the chief of that Air Force, Count Carl Gustaf von Rosen, took over a further Safir in which he made his world-famous non-stop flight Stockholm—Addis Ababa on the 9th May 1947.

South America is an extremely air-minded continent and the Safir is of course represented there also. It has found enthusiastic friends both in the Argentine and Brazil. I have seen reports of test flights which resemble drafts for propaganda purposes rather than test reports. It is my belief therefore, that the Argentine and Brazil merely constitute the first stage of the South American market. Europe, America and Africa, these only represent three parts of the world. Now however, barely three years after its birth the Safir has also conquered Asia. On the 27th April 1948 three Safirs started from Sweden, the destination of one of which was Bombay whilst that of the other two was New Delhi. This delivery flight has now been completed and the Safir has thus been introduced in four parts of the globe. With this achievement the pioneering period of the plane may be said to be terminated. Delighted Safir owners undoubtedly represent the best means of introducing the machine since they are strongly in favour of others becoming owners of a Safir — the gem of the air.

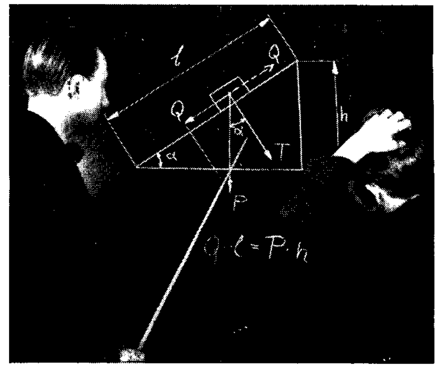


Safir passengers from the Pole Circle to the Equator. Above, the Safir is being boarded by a representative of the nomad tribe, the Lapps, and on the right Ethiopian crews are waiting to pilot four Safir planes from Stockholm to their distant homeland

TECHNICAL EDUCATION

by

Anders Widengren
Principal of Saab's Technical Training School



The greatest importance has at all times been attached to the combination of practical skill with theoretical knowledge. Just as an industrial undertaking upholds its position against competitors through the organizing capacity and inventive genius of its engineers, so must it base its future existence on the individual skill of its workers. Notwithstanding all available technical resources, specializing and mechanisation which is replacing manual work by machinery to an ever increasing extent, the metal industry has been unable to dispense with the services of competent and skilled workmen. It is essential for high quality production such as that of Saab that an ample supply of skilled labour should be available. Even in the early days of the company difficulties were experienced in obtaining competent workmen in sufficient numbers. In the circumstances it was very natural that Saab should take upon itself the work and expense of providing a technical training on systematic lines. A step in this direction was taken before the outbreak of the World War II, when the "assembly training school" was started. The course in this school extended over a few weeks, and in addition to a practical training in all forms of assembly works, newly engaged sheet metal workers were also able to obtain a few days theoretical instruction. But Saab did not rest satisfied with this rapid training course alone; they went the whole length and in the late summer of 1942 the doors of Saab's technical training school were opened to receive the first batch of student apprentices.

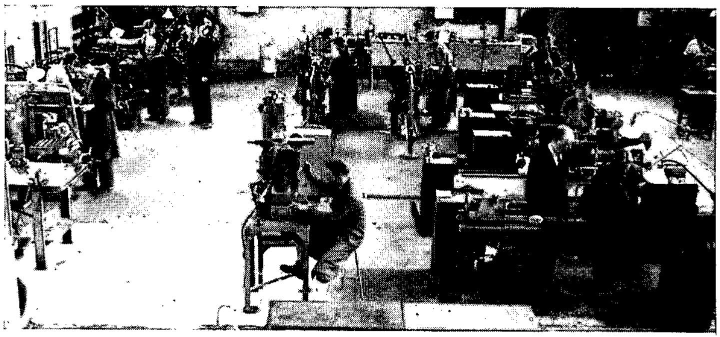
During the first four years of its existence the school was located in rented premises outside the Saab factory area. On the completion of the underground factory, however, space became available within the Saab works and the school was able to move into its present quarters. These are located in a bay of one of the erecting halls and are entirely separated from the other workshops. The rooms are light and airy and are suitably equipped for the requierements of the school.

The Task of the Technical Training School

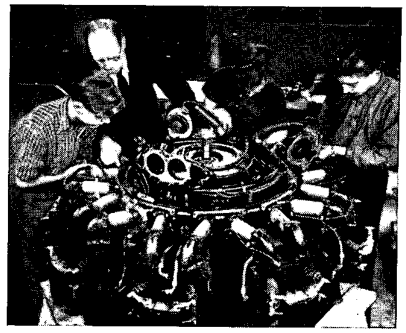
is to train up apprentices to become proficient fitters and machine operators in our workshops by giving them a sound grounding in both practical and theoretical subjects. On this account the instruction is planned on lines adapted to Saab's production and organisation. Furthermore, the activities of the school facilitate the recruiting of works foremen to some extent. The leading workmen and foremen are selected amongst the most competent of the apprentices when the latter after completing their course have been out in the workshops for some years and have proved themselves suitable for such advancement.

The period of training lasts for 4 years.

Mr. Anders Widengren



Practical instruction is given in spacious light premises in which the apprentices learn to operate the different machines under expert-supervision



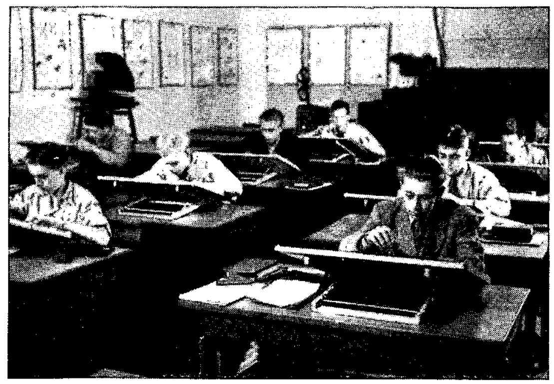
In the subject the theory of engines, amongst others, the boys must dismantle and re-assemble an aero-engine

New pupils are taken in each year, and the number of apprentices attending the school is about 60. The minimum entrance age is 14 years, the maximum age being 16, but in exceptional cases youths who have already turned 17 are accepted. The maximum age limit has been set as low as 16 for the reason that we wish the apprentices to remain in the school for at least 4 consecutive years without being obliged to interrupt their training on account of military service. It is also undesirable to allow too long an interval to elapse after they have finished their ordinary school education. From the point of view of instruction also it is preferable that the difference in age between pupils in one and the same class should not be too great. Other conditions for acceptance as an apprentice are that the applicant must have reached at least the 7th class in the Elementary School, and that he is passed by the doctor as fit for work in the shops.

Admission Tests

Applications for admission to the school must be received approximately six weeks before the beginning of the new school year, which starts immediately after the works holidays. After a preliminary thinning out which is based on the applicant's school-leaving report — particularly with respect to mathematics, grammar, drawing and handicrafts — the youths selected in this manner must undergo an examination both of a theoretical and psychological nature.

The theoretical tests are two in number. One of them comprises a few simple calculations and in the other the applicant is required to read some suitable passage aloud and then reproduce it in writing.



Practical and theoretical training always go hand in hand. A lesson in machine drawing is in progress here. The film projector and ballopticon, both of which are employed in teaching, are visible in the background

In the psychological test the so-called " Minnesota Tests " are applied. For these tests two " batteries " are employed, each containing two modelling boards, a sheet of paper for form division and a tool assembly box. The test with the modelling boards is carried out by asking the boys to transfer a number of sawn-out wooden blocks of different shapes with one hand from the cut-out portions in one board to those in the other and from the latter back again to the first as quickly as possible. The cut-out portions in the two groups are arranged differently. Figure division consists in allowing the boys to attempt for a quarter-of-an hour to divide up as many of the unitary forms shown on the sheet as possible into the separate forms indicated at the side of the unitary forms. Finally, the assembly tool box contains tools and other articles of a practical nature which have been taken apart at the beginning of the test. These articles must be re-assembled satisfactorily in the shortest possible time. The results of the three tests are combined and a final number of points awarded in accordance with certain formulae.

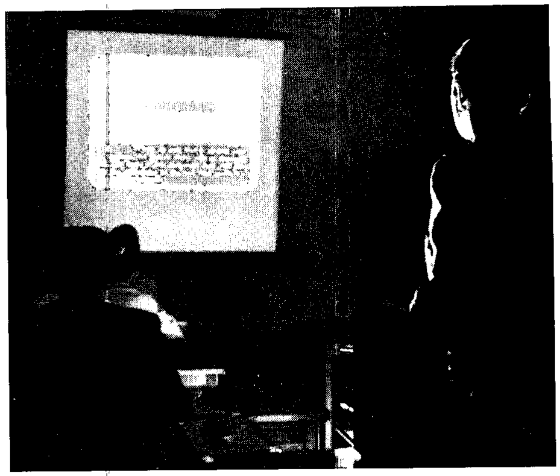
The two theoretical tests are preceded by a simple oral text in which certain questions — which might be called "intelligence questions" — are put to the applicant. Attention is also paid to the boy's general deportment.

The 15 boys passing this examination most satisfactorily are allowed to enter upon a 6 months trial period during which their aptitude is the subject of further observation. If this trial period is found to yield satisfactory results both for the company and the apprentice, a 4-year contract is exchanged between Saab on the one hand and the apprentice and his guardians on the other. Thus the contract expires with the termination of apprenticeship and the new craftsman is at liberty to enter some other concern if he so desires, though Saab of course prefers that he should remain with the company.

Instruction

Practical instruction naturally fills up the greater part of the training time. During the two first years the apprentice is trained exclusively on the school premises in which, in addition to work-benches, the following machines are available: 4 lathes, 1 bench lathe, 2 turret lathes, 2 shapers, 3 milling machines, 1 tool grinding machine, 1 universal cylindrical grinder, 1 four-spindle drilling machine, 1 pillar drilling machine, 1 band saw, 1 hack saw, 1 contour saw, 2 (double-ended) grinders, 1 screw press and 2 bench shears. In the third year the apprentice is placed out in the shops where he is moved from one department to another in order to obtain as wide an experience as possible, and he can at the same time learn to find his way about in the Saab works. He is still under the control of the training school however.

The three years' basic instruction includes, on the average each year: bench work, tracing and drilling 25, 20 and 15 weeks during the first, second and third year respectively, turning 10 weeks, milling, shaping and grinding 5 weeks each, tool-room service 5 weeks during the second year, control and measuring 5 weeks in the third year and welding 5 weeks during the third year. Only in the fourth year may the apprentice begin to specialize in the branch that appeals to him and for which he is suited. This transference to a definite branch of work



Slide films are found to be a very effective supplement to verbal instruction

is preceded by a comprehensive discussion between the teaching staff of the school, the workshop management and the apprentice himself. Satisfactory guidance is offered in this connection by the continous record kept of the apprentice's capability and behaviour and the interest he has shown. Obviously it is extremely important that the trained workman should be employed on the work for which he is best suited, since only under such conditions will the training yield the best results for himself and the company.

The weeks spent on the machines and at the benches are not arranged consecutively but are divided up into short periods. In this connection investigations have shown that a training which allows various repetitions achieves the desired end more quickly and yields more permament results than is the case, when each subject is dealt with in a single sequence. Moreover, practical instruction is so arranged that during the early days the apprentice can carry out certain practical exercises in each branch of work. Thus a series of exercises of increasing difficulty have been prepared for filing, turning, etc. At the end of a certain period the length of which depends upon the apprentice's ability and interest, he is allowed to begin work on some of the parts required in production. Productive work is encouraged to the greatest possible extent since it is the value of such work that helps to balance the costs of running the school. It is of advantage moreover, that the apprentice while still in the school should become acquainted with the tasks he will encounter at the work benches and machines out in the workshops, to say nothing of the satisfaction and creative pleasure he experiences in making a product that will be actually employed.

The apprentice is also allowed to complete his tool set for which he has signed a receipt, by making centre punches, scribers, chisels, screwdrivers, squares, inside- and outside callipers, etc. himself. These tools become his own property on the conclusion of his training.

The theoretical instruction imparted by the school's own teaching staff is restricted entirely to the daytime, and is carried on during the first three years for approximately 40 weeks each year. It includes the subjects of workshop technique, the theories of materials and machines, technical calculation, drawing, the theory of aeroplanes and engines, grammar and citizenship, also lectures on time studies, industrial economy, hygiene, and industrial and labour legislation. The lectures are held by members of Saab's staff dealing with such matters. In addition, the school radio is used as an auxiliary to the instruction which is further supplemented by educational films. For the latter purpose the company's light projectors consisting of a 16 mm film projector, a strip projector, sciopticon- and ballopticon apparatus are available. No theoretical instruction is given during the fourth year. In place of it, the apprentices must give a discourse on some subject with which they have come into contact and which particularly interests them. Their audience consists of their comrades and the school teaching staff. Finally, it may be mentioned that the apprentices are allowed to make visits to other works as a part of their education. In addition, the fourth class go on a longer study trip on the completion of their training.

The number of hours devoted to theory is 8 in the first class, 6 in the second class and 4—5 in the third class. Apart from the foregoing, 2 hours are set aside for gymnastics and sport in the first and second classes and one hour for the third class. This covers a total of 740 hours theory and 200 hours gymnastics and sport during the whole course of training. This instruction schedule may appear somewhat too comprehensive at a first glance, but the 740 hours of theory only represent 7.5 % of the total working time during the four years.

On completion of the four-year course the apprentice receives a leaving certificate with a report on his competence and skill, and in specially deserving cases a diplome is awarded. On the basis of this report and the observations made concerning the apprentice during the fourth year he is finally placed in the works in the position for which he is found most suited.

Advantages

The instruction is given entirely free of charge and the apprentice receives and hourly wage both during the theoretical and practical training. At the present time renumeration is at the rate of 36 Swedish öre for the first half-year, increasing successively by 5 to 6 öre for each half-year, so that the apprentice receives an hourly wage of 76 öre during the eight half-year to which an emergency supplement is added in accordance with the current index figure. On drawing up the contract, moreover, a sum of 192 Swedish crowns is placed to the apprentice's credit in a savings bank book. This sum, together with a " renumeration for diligence " — 4 öre per working hour — amounts to about 600 crowns, and is placed at the pupils disposal as a bonus after he has passed through the school. From and after the seventh half-year the apprentice may be placed on piece-work where this is feasible.

The company's interest in the apprentice does not cease on the conclusion of working hours, but also embraces his leisure time. Thus, on two evenings a week the school premises remain open for leisure-time occupation, which affords the apprentice an opportunity of cultivating his particular hobby. The company has also presented the school with a building set for a glider plane which is now being assembled in the Linköping Flying Club's premises under expert guidance.

The school also has a club of its own, the Training School Sports- and Social Club (YIK) the purpose of which is to increase the interest in gymnastics and sport and foster good comradeship. The business of the club is managed by the apprentices themselves under the superintendance of one of the school's instructors. In this way the apprentice can also obtain an insigth into the business of club management.

In the education of pupils attending the Saab technical training school an endeavour is also made to form the pupil's character and educate him to become a good and responsible citizen.

Editorial

The three Saab Safir planes which started from Sweden on the 27th April with India as their destination landed in New Delhi on the 7th May according to program, only two hours later than the estimated time — a fine performance both on the part of the pilots and the planes.

The leader for the trip, Captain Anders Helgstrand, has returned to Sweden by ordinary traffic plane, and has nothing but good to say of the Safir's behaviour during the long journey.

The Saab Scandia has now flown for a total of 350 hours during the testing period, 196 hours of which have been flown after the overhauls and modifications carried out last winter.

In the middle of May a test flight was made in the form of a flying visit abroad. The aircraft first flew from Linköping to Oslo, and on the following day to Newcastle in England. After a stop of two hours at the latter place the plane flew back direct to Linköping. This is not the first occasion on which the Scandia has made a trip abroad. Visits have been paid to Denmark, Holland, Belgium and Switzerland at an earlier date.

The interest of the Norwegian and Danish Airlines in the Scandia has been shared by the Finnish Aero O/Y, the chief of which visited the Saab Works in April for the purpose of studying the Scandia.

Interest in the Swedish traffic plane has also been exhibited outside Scandinavia however. Two prominent members of the Dutch Airlines, the KLM, paid a visit to Saab in April and in May a demonstration with the Scandia was given at Bromma, Stockholm, for the director of the Swiss Airlines "Swissair" and the head of the Swiss Air Traffic Board amongst others.

Saab's civil planes represented the chief source of interest for two representatives of the Air Services of India who honoured Saab with a visit in June. Exhaustive demonstrations were given both with the Scandia and the Safir for these visitors from a distant land.

In July Saab had the pleasure to see a representative of the Belgian Airlines "Sabena" as their guest at Linköping. The visit, of course, was primarily made in order to study the Scandia.

The "Thulin Medal" — an outstanding Swedish distinction for aviation research work, instituted in 1944 — was awarded in May this year to F. Wänström and A. J. Andersson, both employees of Saab. The medal has only been conferred on one previous occasion.

On the 19th June a Saab engineer held a discussion for his doctorate, under the title "Stress distribution in aeroplane shell constructions" and the sub-title "Some methods for the determination of the stress distribution in aeroplane shell constructions and with special consideration to the stress distribution in flat or slightly curved shells". The man on whom the title of "doctor" has just been conferred is Thorkild Rand and the investigations for his doctorate were undertaken in connection with work carried out for Saab relating to investigations concerning increased strength problems for aeroplane shells.

The value of Dr. Rand's investigations will be appreciated from the fact that by means of the new methods the same calculations, which formerly occupied 8 men for a period of 8 weeks, can now be completed by one man in 1½ weeks.

Temperature Measurements from Aircraft

The accurate measurement of the temperature of the external air is a matter of considerable importance in flying tests, particularly when flying at high speeds. The instruments hitherto available for the purpose have been found somewhat unsatisfactory and Saab has consequently developed a temperature recording device of its own. In the following pages Mr. Sven Svensson who has been engaged on this work describes the problems associated with this special measuring equipment.

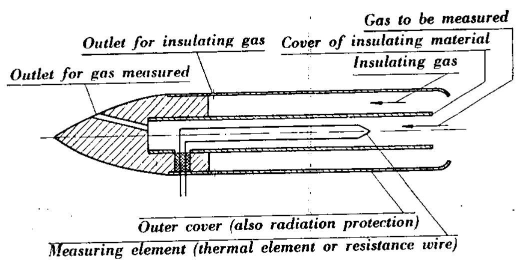
The rapid development of high speeds for aircraft has given rise to the need for temperature recording apparatus which can record the actual temperature of the high-velocity air currents. It is essential to know the temperature of the external air in order to calculate the performance of an aeroplane with the assistance of the test flight results. The temperature may vary with great rapidity in the course of certain tests such as nose-diving for example, so that in addition to indicating an accurate static value, the temperature recorder must also be able to follow the changes closely. An accurate temperature recorder is required in numerous other cases, and in some instances its dimensions must be as small as possible in order to reduce the disturbances of the air current. In all probability the need for accurately determining the temperature of the discharge in jet planes will assume a constantly increasing importance. The problem to be dealt with here relates to great speeds in combination with high temperatures.

Principles

A measuring element placed in a gas flowing at a high velocity indicates a temperature that is higher than the actual temperature of the gas. The increase in temperature is due to the heating up of the gas on compression and friction against the measuring element (friction is a slowing down of the gas layer nearest to the measuring element — the boundary layer — and is thus of the same character as compression). According to the principle of energy the temperature rise on the slowing down of a mass of gas is solely due to the velocity of the gas before and after the change of velocity and to the exchange of heat of the gas with its surroundings. In air this rise may be as much as 45° C at a speed of 300 m/s. The same conditions apply also when the slowing down is caused by friction, since the innermost portion of the boundary layer will also become entirely stationary. When the measuring element is placed directly in a gas flowing at a high velocity the temperature rise will be less than if the gas were slowed up immediately in front of the measuring element which is the case when using a so-called "staudruck" thermometer. This is not due to the different velocity of the gas nearest to the measuring element but to the varying relative heat exchange with the surroundings of the gas which has been completely arrested. The heat exchange in turn is dependent both upon the form of the measuring element and recording device and upon the condition of the gas density etc.). In this respect the height above sea level influences temperature measurements made from aircraft and this is particularly noticeable with the friction thermometers which were usually employed hitherto. In view of the difficulty of determining the influence of the height, thermometers of this type are not sufficiently reliable for the accurate recording of temperatures.

Mr. Sven Svensson

The provision of a thermometer entirely free from correction, by producing a vacuum that varies with the velocity seems to be impossible.



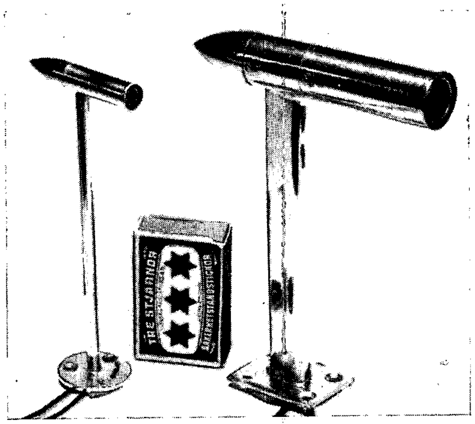


Fig. 1 and 2. The insulating temperature recorder developed by Saab, shown diagrammatically above and in its finished form below. The small recorder has a thermal element, and the large one a resistance wire as the temperature-responsive member

Simultaneously with the reduction of pressure, the density is also reduced and the pressure can only influence the correction through variation of the heat exchange with the surroundings. Difficulties are likewise encountered in attempting to form the temperature recorder in such a way that the heat given off to the surroundings counteracts the temperature rise; the dependence upon height and the factor of uncertainty may be relatively great.

The actual temperature of gases flowing at a high velocity may also be determined directly by means of radiation methods which, however, are probably not so reliable at low temperatures. Furthermore, there is some difficulty in applying these methods during flight tests.

In these circumstances Saab decided to employ a temperature recorder the measuring element of which is placed in the gas current. The requirement in this respect was to produce a form which allows as little exchange of heat with the surroundings as possible in the gas to be measured without at the same time rendering the recorder too complicated.

The form of the recorder necessary to meet these requirements is dependent to a great extent upon the conditions prevailing during the measurements. A sufficient quantity of gas must of course be slowed down for the greater part in front of the measuring element, that is to say, the so-called "staudruck"-principle must be applied. But for measurements carried out in the hot discharge air of a jet plane for example, where the chief heat exchange with the surroundings takes place by radiation to the cold adjoining walls an entirely different form is required than is the case when measuring the temperature of the external air during flight. In the latter case the radiation — usually consisting mainly of solar radiation — is of a very much lower order of magnitude than in the first-named instance. According to preliminary calculations and tests carried out, a temperature recorder constructed on the principle illustrated in Fig. 1 will allow sufficiently accurate insulation of the gases to be measured at the temperatures and radiation commonly encountered when measuring the temperature of the external air.

The Adiabatic Correction Curve

A temperature recorder the heat exchange of which with the surroundings can be neglected has a so-called adiabatic correction curve. Fig. 3

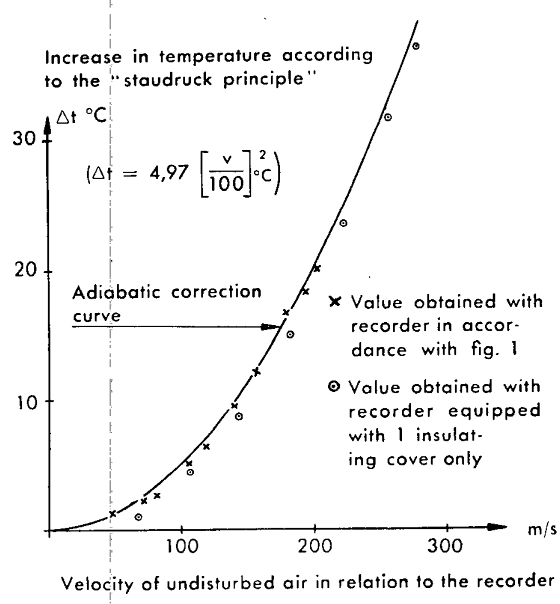


Fig. 3. The adiabatic correction curve for dry air at about ± 70° C and a pressure below 2 atmospheres. The values indicated have been obtained during tests with the thermometer centrifugal arm in Fig. 4. Temperature recorders partly designed in accordance with Fig. 1 and partly equipped with a single insulating cover have been employed here

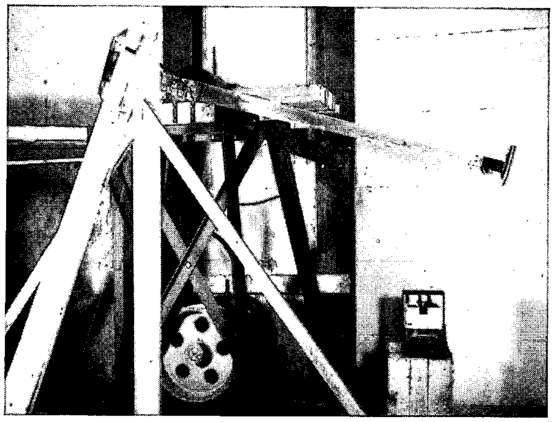


Fig. 4. Thermometer centrifugal arm with which a peripheral speed of nearly 300 m/s can be attained

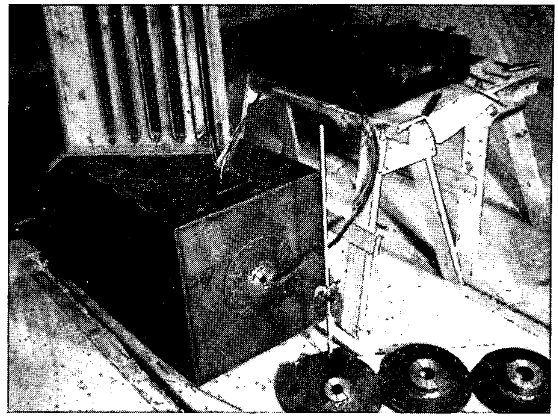


Fig. 5. Temperature measurement with Saab's recorder placed in the air jet flowing from a container. The interchangeable nozzles are shaped to allow adiabatic expansion of the air jet

shows a curve of this kind for air, applying to temperatures round about 0° C. The curve is dependent upon the specific heat at constant pressure (Cp) of air which varies with the air's pressure, temperature and moisture content. The effect of the pressure may be neglected below 1 to 2 atmospheres, that is to say, the conditions usually encountered during flight, and similarly, for dry air, the effect of the temperature with the temperatures of $\pm$ 70° C commonly occurring may be overlooked. At high temperatures however, the correction curve will be changed — at + 150° C the deviation will be 1 % and at + 800° C about 15 % from the curve illustrated.

The effect of moisture under ordinary flying conditions may, generally speaking, be neglected up to the point of saturation. Above this point the curve shown in Fig. 3 will not apply as the heat is then absorbed in the vaporisation of a part of the water. On this account where accurate information regarding the temperature of the external air is required, flight tests should not take place in clouds charged with moisture for example, even in cases where these are not otherwise detrimental to the test.

From what has been said above it will be realised that the correction curve shown applies to air at the pressures and temperatures which may be encountered during flight provided that the moisture lies below the saturation point.

Measuring Equipment

Either a thermal element or a resistance wire may be employed as the measuring element. A thermal element possesses the advantage that it occupies little space so that the dimensions of the temperature recorder may be kept low. For the accurate measurement of slight differences of temperature however, highly sensitive instruments are required for recording the thermal forces. Apparatus of this kind is usually somewhat clumsy and therefore unsuitable for flight tests. The resistance wire in its turn necessitates a somewhat larger temperature recorder but does not otherwise entail the use of special measuring instruments. In the recorders developed by Saab a resistance wire is used almost exclusively — usually consisting of a special, pure nickel wire. The effect of the temperature on the resistance wire is as a rule measured by means of a crosscoil instrument the relative insensitivity to voltage variations of which renders it possible to employ the d. c. voltage of the aircraft system. It is necessary to connect up a series resistance however, as the current flowing through the resistance wire must be less than 10 mA in order that the heating up of the resistance wire and the gas to be measured may be neglected. Certain flight tests necessitate the use of an oscillograph and in such cases it may also be of interest to record the temperature of the external air by means of this instrument. The resistance wire of the temperature recorder is then employed as one arm in a Wheatstone bridge the out-of-balance current of which is recorded by the oscillograph. The latter is fed from a separate battery and in this case also the current through the resistance wire should be below 10 mA.

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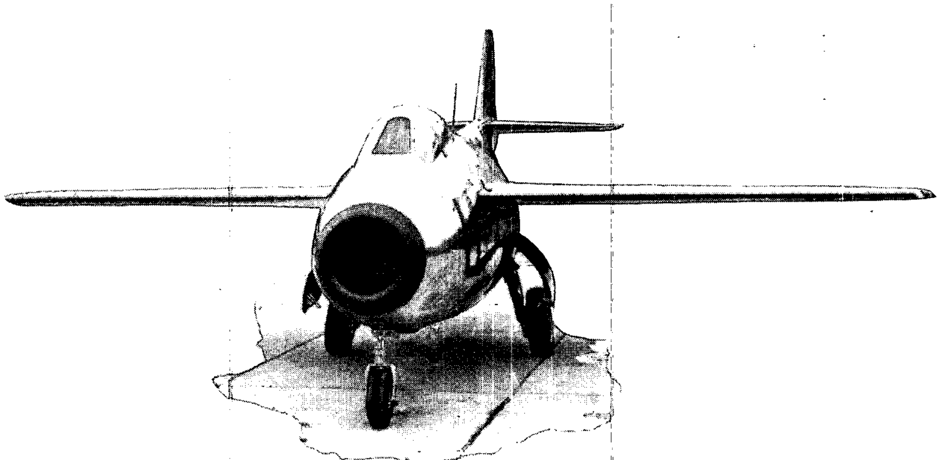
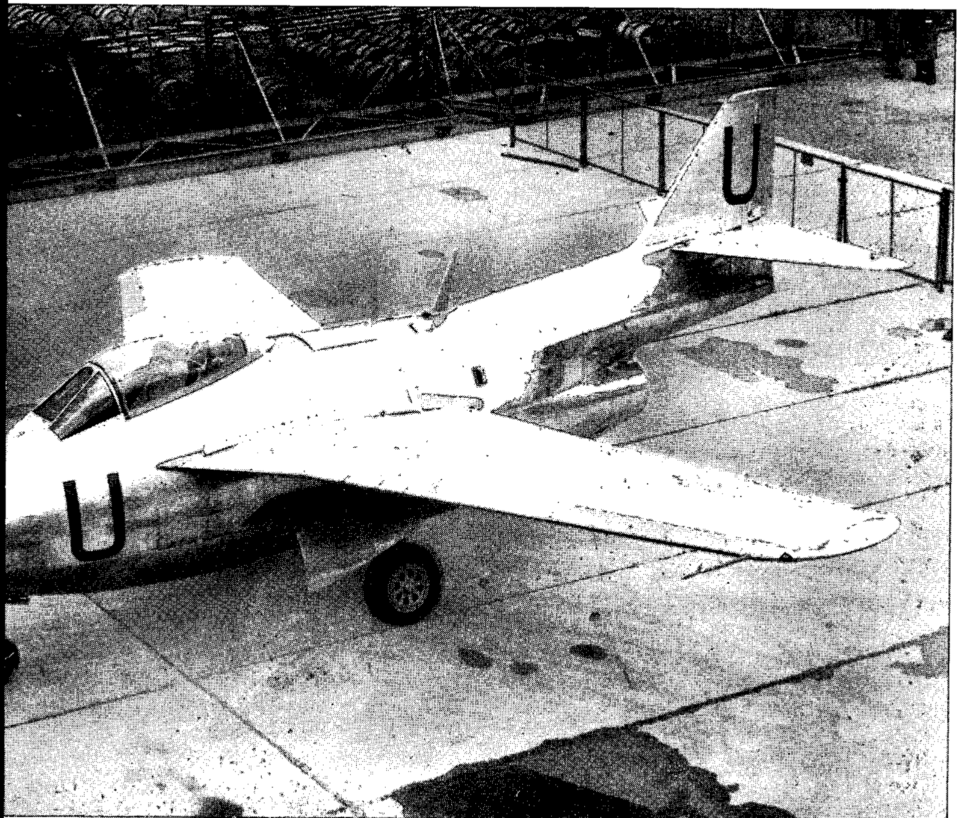
The Saab-29





The Saab-29 is a single-seater jet fighter plane having a maximum speed calculated to exceed 1,000 km/hr. The principle followed in its design has been to place all the equipment such as the landing gear, the fuel tanks, armament, etc, in the fuselage, thus permitting the wing to be constructed in the form of a rigid, smooth shell which is not weakened by the presence of doors or the like. Notwithstanding the somewhat full shape of the fuselage, it has been possible to keep the air resistance low. The air of combustion is drawn in through a circular intake located in the nose and passes through a straight, polished duct to a jet engine of the de Havilland "Ghost" type which develops a thrust of approximately 2,200 kg. The adjustable stabiliser on the tail has been placed high up on the fuselage to protect it from the outflowing gas jet. With this arrangement the discharge pipe can be shortened and the landing gear placed low down, whilst the risk of damaging the tail on landing is eliminated. The wing which has a pronounced sweep-back is fitted with automatic slots which improve the stalling properties on landing and at low flying speeds. As in the Saab-21, the pilot's seat can be shot out by an explosive in the event of a parachute jump, and the top of the pressurized cabin can also be shot away by an explosive discharge. The wind tunnel tests have been of an extraordinary far-reaching nature and have been supplemented by practical flight tests to half-scale, for which purpose a Saab Safir has been fitted with a wing structure of the same form as that of the Saab-29. The lower picture on the left shows this combination and the other two pictures show rather clear the appearance of the Saab-29 with the arrow-shaped and very thin wing, the high tail unit, and the thick fuselage. During the extensive flight tests—the first of which is anticipated to take place in the autumn—we hope to publish further articles in Saab Sonics describing our first "1,000-kilometre plane" in greater detail.

A New Saab Invention —

self-marking target towed by aircraft

A self-marking target has been invented by Saab which is primarily intended for towing by aircraft. The originator of this idea is Mr. Torsten Faxén who, in collaboration with Dr. Erik Wilkenson, has produced a system of target marking which is likely to revolutionize shooting practice both for fighter planes and anti-aircraft defence units.

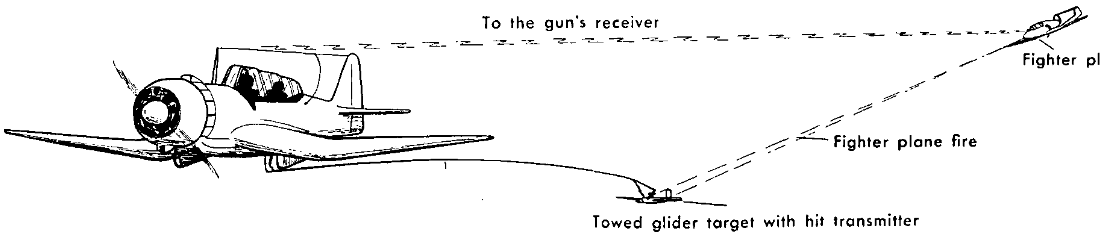
The system of practice-shooting at a target towed by an aircraft, which has been rendered possible by Saab's invention, differs very appreciably from earlier methods. Hitherto it was necessary for the "towing sleeve" to be lowered and for the fighter plane pilot to land before he could ascertain his scoring results. By means of the new invention, however, the result of each shot can be communicated to him while he is actually firing, an advantage which is self-evident from the point of view of training. At the same time the work of firing is facilitated and rendered more efficient, whilst a saving in flying hours and fuel is effected.

The construction of the "Hit Indicator BT-13", as the new invention is called, is illustrated in general outline in the accompanying drawings. The operating principle is based on the fact that the shock wave of the projectile sets up radio signals through the medium of a special microphone built into the target, these signals being received by the marksman. Thus the main portion of the installation is the so-called "hit-transmitter" — a stream-lined body enclosing the microphone. The influence of the air stream, the dynamic pressure and other disturbing effects caused by the towed target has been eliminated and it is the actual sound impulse set up by the projectile as it passes through the target zone which gives rise to the signal in the microphone.

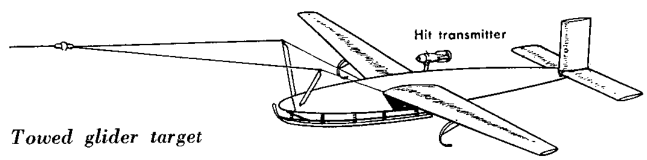
From the hit-transmitter, conductors pass along the towing cable to a recording apparatus in the towing plane. The records are either read off by a person who informs the marksman verbally by radio of the result of his shots, or the marksman may himself receive a radio

Mr. Torsten Faxén

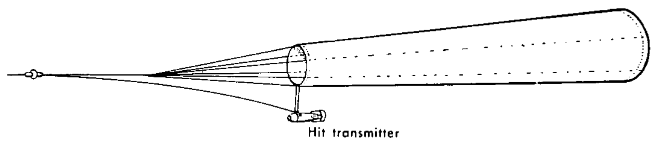
Dr. Erik Wilkenson



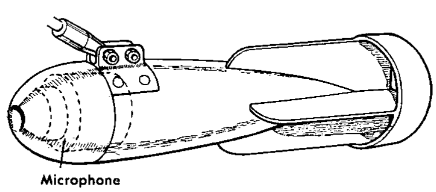
Elementary sketch of the action of the hit indicator



Towed glider target



"Towing sleeve" equipped with hit transmitter



Hit transmitter

signal for each projectile which passes through the target zone. The recording apparatus is fitted with a counting mechanism for recording the number of hits, and it is further provided with a device for varying the size of the target area. The zone within which hits can be indicated may be varied between 0,5 and 8 meters in radius according to the skill of the marksman and the calibre of the projectile, so that the degree of difficulty can be adapted to the stage of training attained.

In view of the fact that the invention is primarily intended for use with targets towed by airplanes, the weight of the equipment has been kept as low as possible. Thus the recording apparatus only weighs four kilos, the hit-indicator two, and the batteries for generating the current barely twentyfive kilos. The airborne parts occupy very little space and can be conveniently mounted in the towing plane.

The new method permits the employment of very much smaller targets, since no marking of the bullet holes is necessary. On this account the speed of the target plane may be increased and practice can be carried out under more realistic conditions.

A hit-indicating device of this kind may of course also be employed for targets on land or at sea, either stationary or towed. It thus possesses an all-round military value and in addition to this the employment of it means a considerable saving of the time of training and makes training more efficient, as the results of the shooting can be read off immediately. Furthermore, the practice-shooting with this hit-indicator will be much more economic than the present methods, which is still one reason for the great interest in this new invention that has been shown by the military authorities.

It is quite evident that the hit-indicator BT-13 will be of a very great value for the training of fighter pilots and anti-aircraft defence personnel, and there is no doubt that the adoption of this self-marking target will give all military practice-shooting an extraordinarily increased efficiency.

The Scandia's Engine Installation

by

Aarne Lakomaa

The Scandia's engines are manufactured by the wellknown American aeroplane engine firm, Pratt & Whitney. The first Scandia model — 90A — is equipped with a Twin Wasp 2 SD 13 G R-2000 type of engine which has an output of 1,450 BHP at take-off and a normal maximum output of 1,200 BHP. Later models of the plane — 90A-2 and 90B-2 (with pressurized cabin) — will be equipped with much more powerful engines of the Twin Wasp R-2180 type of 1,650 BHP at "dry take-off" or approximately 1,800 BHP with methanol- water injection. Both types of engines are quite similar in their design, and consequently the following description of the installation may be said to apply generally to the Scandia's engine construction.

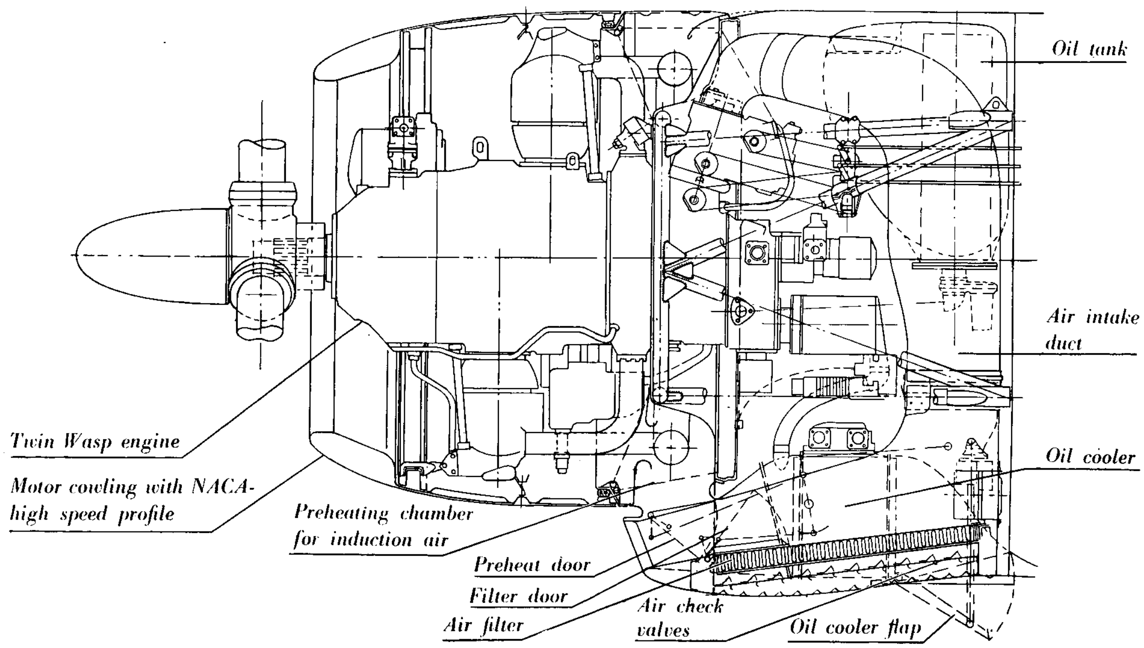
The engines are of the air-cooled, 14-cylinder radial type with the cylinders located in two rows. Each engine is fitted with a single-stage compressor, injection carburettor and double magnetos. Furthermore, a considerable part of the auxiliary apparatus is mounted directly on the engine, including starter, generator, fuel pump, hydraulic pump, two special generators for certain instruments and alternator for the propeller control system.

The propellers are of the four-bladed Hamilton Standard type with hydraulically operated pitch control. The propeller blades can be reversed to a negative angle of pitch, thus producing a braking effect. In this way the landing run may be shortened appreciably in critical cases. The blades are protected against icing by heating up the leading edges electrically. The current required for this purpose is taken from the airplane's common electrical system by means of carbon brushes on the propeller hub. An electrical synchroscope is installed as an aid to the pilot in maintaining synchronous operation of the engines.

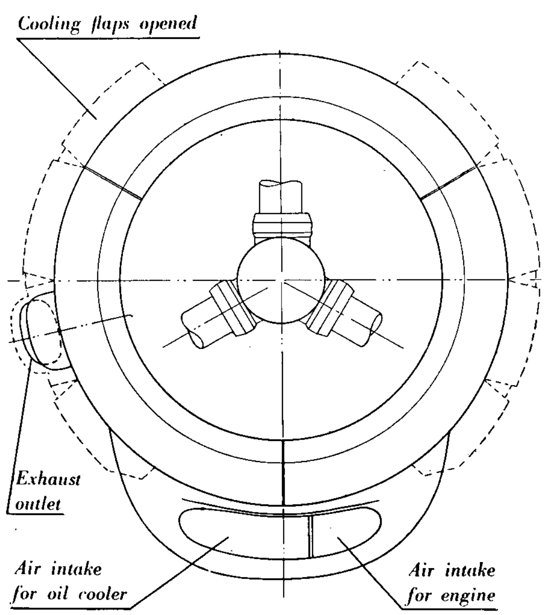
Mr. Aarne Lakomaa

The installation

The engine installation is of the so-called "Power-egg" type, that is to say, the construction constitutes a single unit which can be exchanged in a short time, whilst it may also be employed as a right- or lefthand installation without necessitating extensive changes. All that is necessary is to turn the exhaust manifold so that the opening faces outwards towards the outer wing, whereupon the noise of the exhaust and any flames from the latter will not disturb the passengers. In order to utilise the exhaust jet thrust, the opening is constructed in the form of a nozzle facing backwards in which the exhaust gases are accelerated to a suitable velocity. The energy contained in the exhaust gases is here employed in the same way as in the case of jet propulsion engines, and thus appreciably increases the net thrust.



Diagrammatic side view of the engine installation showing the principal parts



Front view of the engine installation

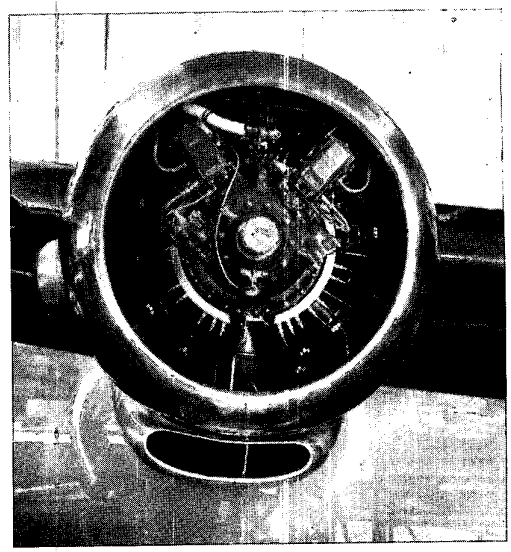
In designing the engine mounting, special importance has been placed on the elimination of vibration so far as this is possible, and with this end in view the engine is suspended in a tubular steel mounting fitted with eight vibration isolators. The mounting is fixed in its turn to the fire-wall.

Air is supplied to the carburettor through a duct which is so amply dimensioned that the air flowing through it is kept at a low velocity, thereby reducing losses due to friction and bends. To prevent icing on this duct and also on the carburettor, the induction air is preheated in a preheating chamber in which the air flows over the hot exhaust manifold and undergoes a total temperature rise of 55—60° C. The temperature of the induction air is regulated by a door inserted in the duct, which is operated electrically from the pilot's cabin. To prevent sand and dust from penetrating into the engine, the induction system is provided with a filter system which is operated by means of an electrically controlled door in the intake duct. The filter system functions in such a manner that coarse filtering first takes place by inertia separation in which the heavier particles are removed from the induction air. Fine filtration is then effected in the filter block itself. By employing this double system the cleaning of the air is carried out more effectively and the filter does not require cleaning at such frequent intervals. It is true that the filter system causes a certain pressure drop in the induction air which reduces the engine output, but this reduction of output is compensated by the take-off margin of the engine.

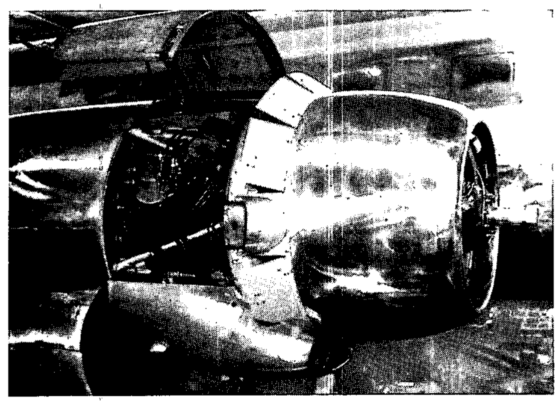
Rain water constitutes a danger from the point of view of icing at certain temperatures, and for this reason water drops in the suction air are separated out by a thresold in the intake duct, and are led to a plenum chamber from which they drain into the open air.

In view of fire hazards the entire engine installation is so designed that the possibility of a fire spreading has been reduced to a minimum. Thus, the engine with the exhaust system is entirely separated from the accessory compartment behind it by an engine diaphragm of stainless steel plate. This highly resistant material has likewise been employed for that part of the engine cowling located at the back of the exhaust outlet and cooling flaps, as well as for the exhaust system which is of the conventional form, consisting of the manifold and common exhaust pipe. The accessory compartment referred to above is separated in turn from the engine nacelle by a fire-resistant fire-wall which also consists of stainless steel plate. Fire-resistant material has likewise been employed for important details such as the oil tank and induction system. Furthermore, the entire installation is equipped with effective fire-extinguishing apparatus and a fire alarm system.

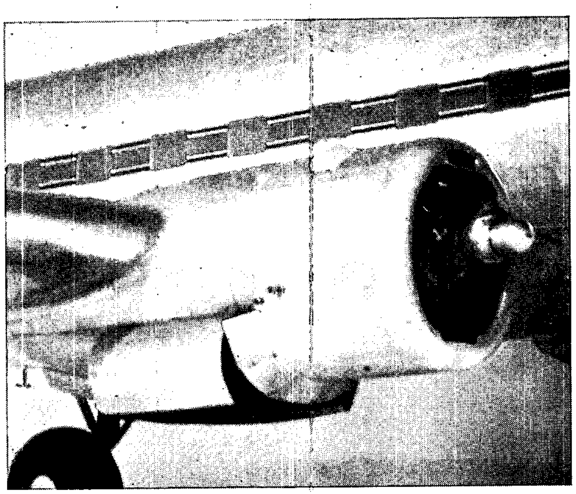
The front portion of the engine cowling, known as the cowlring, has been designed to offer the minimum overall drag and the most effective pumping of the cooling air. The nose of the cowling is an annular NACA-high speed profile (NACA 1-serie). For regulating the quantity of the cooling air, cooling flaps are provided which are located behind the engine cowlring and are operated electrically from the cockpit. After flowing through the engine, the cooling air is led out, through the exit duct the form of which is suitably designed from the point of view of air flow by the provision of shoulder baffles on the exhaust manifold. In

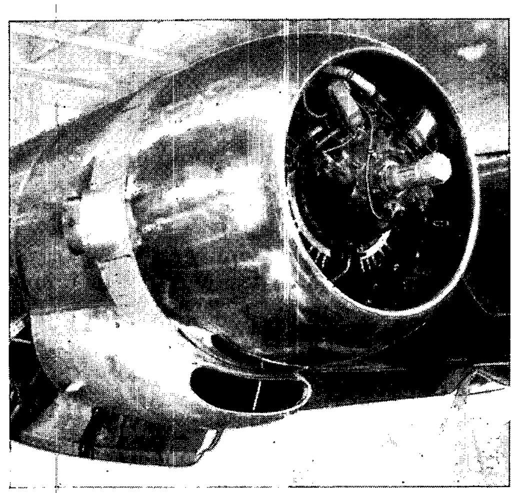


End view of the engine installation completely assembled. Immediately to the left of the engine nacelle the air intake for the wing anti-icing system may be seen

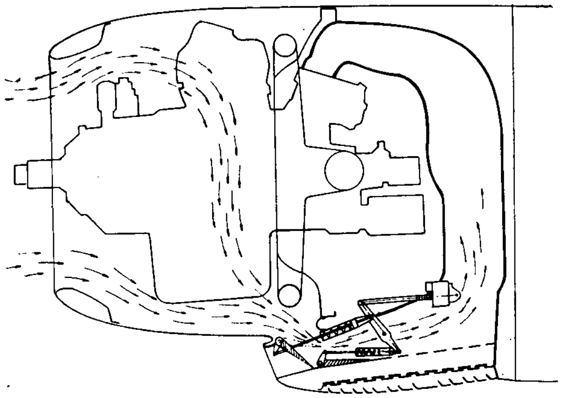


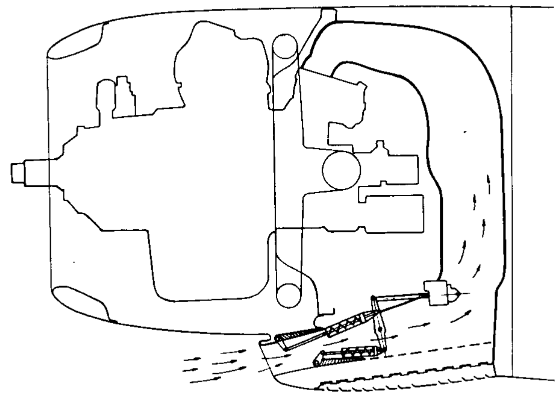
Engine nacelle with the panels and the cooling flaps opened

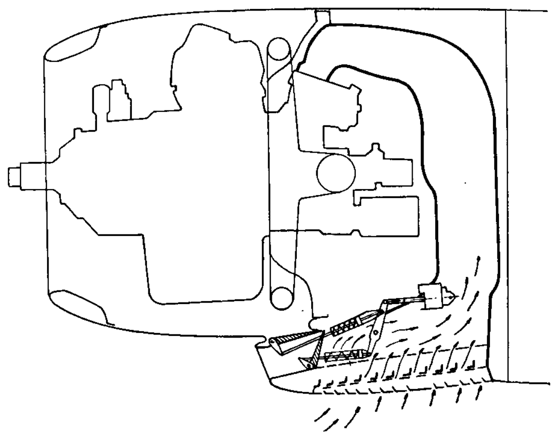




The engine cowling of the prototype (lefthand illustration) differs appreciably from that of the production airplane (righthand illustration)







Valve construction for the carburettor air intake. The above sketch on the right shows the path of the air direct to the carburettor. In the upper lefthand illustration this path has been closed and the air is warmed up when it flows over the cylinders and through the preheating chamber. Finally, the lower illustration shows the position of the valve when the air is forced to flow through the air filter

designing the engine cowlring and the cowling between the engine diaphragm and the fire-wall special consideration has been given to facilitating service- and inspection work as far as possible. For this purpose the entire unit consists of two panels only, which can be conveniently mounted and dismantled.

The oil system

is entirely included in the power plant, before the fire-wall. The oil tank has an oil capacity of 100 litres and is fitted with a circulation cylinder (hopper) in which the air is removed from the returned oil. The oil cooler, which is of the standard air pipe type constructed of light metal, is dimensioned to comply with the conditions prevailing with a single-engine climb at METO-power under + 40° C ambient air temperature. The oil temperatures are regulated by an electrically operated flap in the outlet duct of the cooler. The operation is thermostatically controlled and the temperature of the inlet oil is automatically maintained between + 60° and + 75° C, irrespective of the external temperature.

The engine failure detector represents an important feature from the point of view of safety for the engine and the oil system. It is installed in the oil sump of the engine, in which the return oil collects. In the event of the failure occurring in an engine bearing, fragments of metal may be carried along by the oil circulation. They collect in the oil sump where they sink to the bottom and are drawn to the detector, thereby establishing contact between electrodes which transmit an impulse to signal lamps on the instrument panel. The pilot can then take the necessary measures before greater damage is caused.

The fuel system

is mainly located in the outer wings and the nacelles. There are two fuel tanks in each outer wing immediately outside the connection to the wing centre-section, with a total fuel capacity amounting to about 2,900 litres. The fuel is drawn into the engines by the engine fuel pumps, or it is forced to them by means of a pump installed in each tank. These tank pumps constitute a stand-by and auxiliary system which ensures the fuel supply to the engines in critical cases. The fuel system is designed in such a way that the fuel can be transported from the left- to the right-wing tanks and vice versa with the help of the tank pumps. In conditions of emergency the fuel can be rapidly jettisoned, thus permitting the flying weight to be reduced by approximately 800 kg in 10 minutes. To reduce the fire hazard, when draining the tanks, this process

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Technical Development Work in the Saab Workshops

The continuous advances taking place nowadays in aeroplane designs make heavy demands on the manufacturing processes employed. For the production and assembly of the thousands of parts which go to form the finished aircraft the workshops must have methods of manufacture at their disposal which from the point of view of efficiency must be of the highest standard obtainable. In this article Mr. Arne Svensson, chief of the tooling department, describes the organisation of the technical development work and gives some typical examples of the tasks this work involves.

Technical research work in the workshops has an important mission to fulfil at the present day in the rationalisation of the engineering industry. A distinction is usually made in this connection between basic research and applied research according to the nature of the work. The essential purpose of the first category is to investigate the general theoretical grounds for the working and treatment of materials. The latter form of research is concerned with the application of the experience gained under service conditions with a view to improving production processes by means of technical development work of a practical nature.

From a Handicraft to a Heavy Industry

The production of aeroplanes on industrial lines is a form of manufacture of relatively recent date. It fell to the lot of this industry to develop manufacturing methods suitable for series and mass production in the course of a few years where the work had formerly been carried on solely as a handicraft. In most cases, moreover, this change had to be effected under working conditions which, in view of the hurry and bustle of the present age, were far from ideal. In those days we were almost entirely without experience of aeroplane construction on a large scale. Furthermore, the expansion occurred at a time when for known reasons the exchange of experience with other countries was practically at a standstill. The little information that reached us through a much reduced foreign technical press was for the greater part of no value.

During the same period we developed our first allmetal aeroplane of the monocoque construction type, a circumstance which further complicated our manufacturing problems. Thus, as in the case of so many other industries, we were entirely dependent upon our own resources. An intensive program of experimental and development work was now initiated with the object of adapting the production plant to the changed conditions. On the subsequent removal of all restrictions we were gratified to learn that in many instances we had achieved the same results as those reached by other firms abroad.

Mr. Arne Svensson

Development Work

The need for systematic development work in workshop practice is more manifest in aeroplane production than in any other branch of industry. Developments in the technique of flight advance at an ever-increasing rate and the demands made on the manufacturing departments by project engineers and designers are in step with this progress. Manufacturing problems have to be solved even during the project stage and designs must be carefully scrutinized with respect to their possibilities for series production. This continuous collaboration in the work of planning and series production is one of the essential conditions for rational aeroplane production. It is being observed more closely than ever now that we are making the radical change from a propeller propulsion to a jet propulsion in our military aeroplanes.

It is not sufficient, however, for our designing departments merely to keep themselves informed as to working processes and resources available in the workshops. The men in the shops must look to the future, they must produce new plans and ideas, they must constantly be prepared to adopt new means that will offer a satisfactory solution of manufacturing problems. In this connection systematic development work of a practical nature must be carried on with the object of improving existing processes and trying out new methods and forms of treatment.

This would place a heavy load on the workshops engaged on series production. The hands here are accustomed to working in accordance with a familiar routine. Continuous experimenting with new methods would dislocate this routine unduly and interfere with the rythm of production.

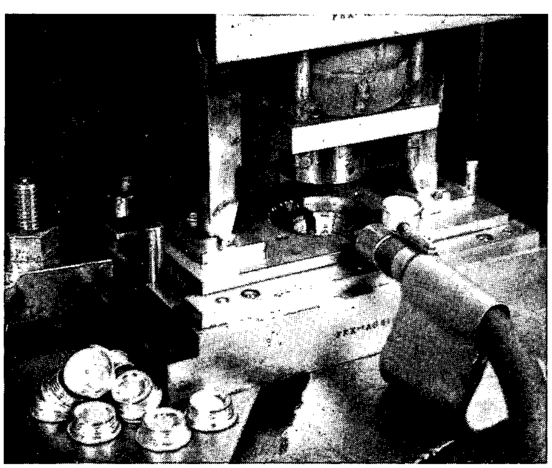

Fig. 1. Rubber pressing in a divided outer matrix with an inner rubber stamp

We insist therefore, that any proposed changes in a production process in use shall be preceded by a thorough technical investigation before they are adopted. This investigation comprises preparatory tests and research work, frequently in the form of detailed experiments, from the course of which it is possible to form an idea of the approximate results. If these are of a positive nature a rough economic calculation is made on the basis of the preliminary tests, and if it is found favourable, the plan is developed with a view to its application to series production. Service tests are then made under conditions approximating as closely as possible to the actual working conditions. In the event of these tests yielding satisfactory results the new method is considered to be ripe for introduction in the ordinary working chain.

It has been found desirable to concentrate this development work as far as possible in a department which is completely independent of the actual series production workshops. The step in this direction was taken some years ago by the inauguration of a technical service department.

Organisation of the Development Work

Systematic technical development work of a practical nature is carried on in the technical service department in intimate collaboration with the workshop- and designing departments. The reports on investigations and tests which are prepared in connection with each commission received are submitted to everyone in the firm concerned. They are classified and filed in the department together with index cards and excerpts from technical literature relating to the subject in question, and constitute a valuable fund of information on workshop practice.

The value of this system is obvious. By the cooperation of everyone concerned the information on workshop matters of a technical nature is available to the whole firm and does not remain in the personal possession of individual workshop employees as is otherwise so frequently the case. Thus in times when frequent changes in the staff are taking place, effective provision is made for the continuity of the work.

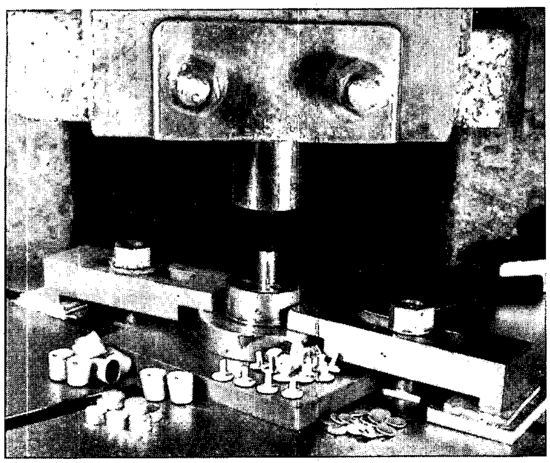

Fig. 2. Cold extrusion of light metal parts

The work of the technical service department is mainly carried on along the following lines.

Development of working methods and tools. The purpose here is to increase the general efficiency of the manufacturing plant by the improvement of existing processes and the development of new methods, tools and machine equipment. The work includes the designing, production and testing of tools and auxiliary machines. It also entails amongst other things the study of developments in workshop practice with the help of technical literature and the consideration of their suitability for application to the manufacture of aeroplanes.

An important feature in the development work consists in the examination of new designs insofar as they depart from the current practice from the manufacturing point of view, and the indication of the most suitable methods for their series production. For this purpose it is frequently necessary to determine the suitability of the proposed method by trial production to full scale.

The workshop equipment must also be supplemented in preparation for the proposed series manufacture insofar as this may be necessary.

Working investigations. The object of these is to ascertain the workability of metal- and non-metallic aeroplane material by cutting and forming, and also to determine the economic working requirements. The work includes the testing of different tool material and the shaping of tools with a view to establishing a general tool standard for different forms of work.

Performance diagrams are then prepared for the different materials, tools and working data on the basis of the investigations. These diagrams may be directly employed for calculating machining times in synthetic piecework for example.

Technical advice and supervision in special technical questions: welding, heat treatment, surface treatment. The working methods here in question call for a technique which is of a totally different character to that adopted for working operations in which the condition of the material does not change during the progress of the work. In welding, for example, the material passes through a whole series of metallurgical processes which the welder must learn to control faultlessly. Careful supervision with respect to expert work is therefore essential. Furthermore, a welded joint must be designed with due regard to the possibilities from the point of view of welding technique. The requirements are more exacting in this respect than in the case of a general design where the designer usually has a greater freedom of choice without running counter to any manufacturing problems.

Very exacting demands are also made of the equipment for such working methods, in order that it may satisfy the requirements covered by the term "aircraft quality".

It has been considered advisable to entrust such matters to specialists and include them in the regular development work. In this way it is possible to ensure treatment from every aspect of problems arising, and obtain effective control of the expert's work and a systematic supervision of the technical equipment of the workshops.

Plans and Ideas

of a more temporary character frequently alternate with the systematic work of development planned for the long view. We have even gone to the length of employing individuals in the workshops from time to time as "idea scouts" whose sole task is to seek for possible improvements in the production system. In this way we have effectively sought means for dealing with the specialist blindness from which workers are liable to suffer when engaged on extensive series production and routine work.

Many valuable suggestions for improved working methods have come from our own workmen. We give our employees every encouragement to participate actively in the develop-

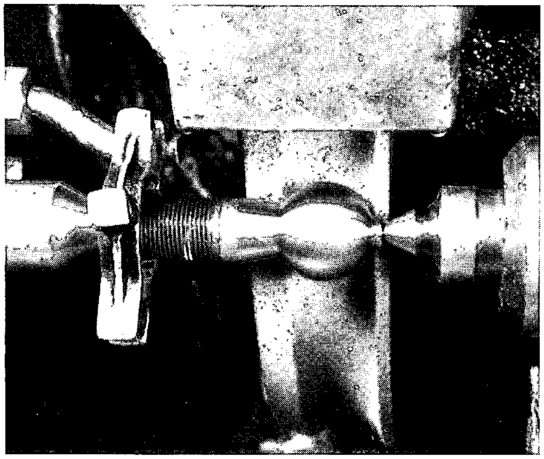

Fig. 3. Form grinding with a precision-dressed grinding wheel

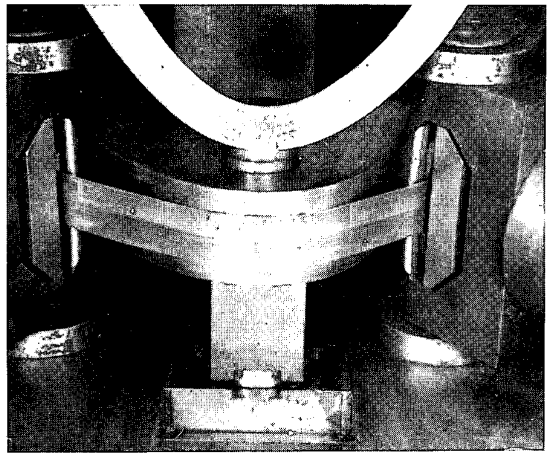

Fig. 5. Investigating the maximum permissible degree of deformation when stretch-forming extrusions

ment work and for the past six years we have been running a special organisation for probing suggestions from the workshop staff. A monetary award is made for every acceptable suggestion.

The Technical Development Work in the Workshops

has resulted in the course of years in a number of greater and lesser improvements which have been adopted to the benefit of the production. A few examples of these are given herewith.

Rubber pressing is a method commonly employed in the aeroplane industry for many years past for the production of simple sheet metal stampings. In principle it is a stamping process in which the sheet material is pressed between the shaping matrix on the one hand and a resilient rubber die on the other. The method has a very extensive range of application, from the simplest flange bending operation to the heaviest stamping. Fig. 1 shows an example of the remarkable possibilities rubber pressing offers. The method has been developed for threading sheet metal caps of the type shown in the illustration. The material is

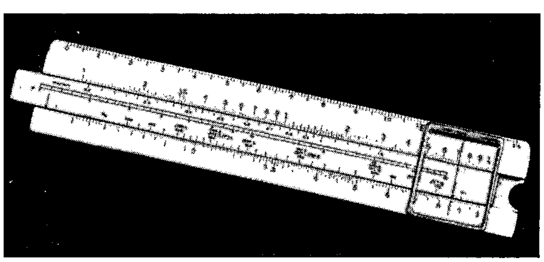

Fig. 4. Slide rule for determining economic cutting speeds for turning

placed in a divided outer matrix and pressing is effected with the help of an inner rubber stamp. The pressure applied amounts to several hundred atmospheres and causes the sheet material to fill out the contours of the outer matrix entirely. This example is of interest inasmuch as it demonstrates the use of rubber pressing for the manufacture of typical mass-produced articles.

The cold extrusion of soft metals is frequently adopted in the production of sleeves and covers. The tool consists of a drilled die and a massive punch, and it is driven by a high speed press. The amount of clearance between the punch and the die is made equal to the thickness of the material in the finished product. The material consists of stampings which are placed at the bottom of the die. Under pressure, the material is caused to flow spontaneously and is thereby extruded into the intermediate space between the punch and the die. The cold extrusion method has been developed further, and we are now also able to press heavier parts and even unsymmetrical articles. Fig. 2 illustrates two examples. In this work the pressure attained is as high as 10.000 atmospheres and makes the heaviest demands on the strength of the tool and its suitable form.

The precision dressing of grinding wheels with peristat rollers introduced in the U. S. A. under the name of "crush dressing" has been developed and adopted. We employ it both for grinding tools and in production work. Fig. 3 shows an example of aeroplane parts which are ground to form along their whole length by means of grinding wheels sharpened in this manner. The degree of accuracy obtained in the dimensions is very high and the life of the grinding wheels and dressing rollers has been found to be surprisingly good.

The method of improving the cutting properties and increasing the life of high speed steel tools by sub-zero treatment has been tried out. Particularly satisfactory results were obtained in this connection with shears for cutting stainless steel plate.

Investigations concerning the workability of aeroplane materials with cutting tools have very naturally been concentrated on the high quality alloyed constructional steels. These materials are available in hardnesses up to 450 Brinell and consequently carbides have obviously occupied a prominent position amongst the cutting tools. Exhaustive tests for wear have been carried out under workshop conditions. This work has been done in parallel with the standardisation of materials, and up to the present, working data have been tried out for turning, planing, milling and drilling work. These are each summarised in cutting speed nomograms from which, with a knowledge of the cutting data employed, the cutting speed for the material in question and quality of cutting tool can be conveniently read off. Nomograms of this kind have also been prepared for cold- and friction sawing and the machine shearing of sheet metal. Fig. 4 shows how a cutting speed nomograms has been transferred to a slide rule.

Carbides with negative rake angles to which so much attention has been directed in recent years have of course also been tried out on our aeroplane steel which is so difficult to work. Good results have been obtained in milling. Thus, whilst the life of carbide milling cutters has been quadrupled, the working capacity has been multiplied six times in comparison with the high speed tools formerly used. Extensive tests have also been carried out with hard steel drills. As the results of these it has been possible to drill hardened armour plate and even magnetic steel without difficulty.

The forming methods such as bending, drawing, pressing and stamping entail an intimate knowledge of the different materials' capacity for forming. Investigations concerning the bending radii and bending angles, drawing radii and drawing conditions have been carried out in connection with the manufacture of sheet metal parts. The minimum permissible bending radius for tubes and extrusions has been determined by tests. The figures thus obtained have been compiled in the form of rules and recommendations for the designing-, tool- and manufacturing departments. Fig. 5 illustrates a test for determining the maximum permissible deformation when bending extrusions.

The technical development work offers a variety of interesting tasks. It likewise allows a good insight into the various phases of the production process. From those engaged in it, however, it calls for skillful judgment free from wishful thinking and premature optimism. Only by the exercise of such qualities can the work be carried on successfully.

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Tests carried out

The correction of a temperature recorder for speed may be checked both by allowing the recorder to have a certain speed in relation to the stationary gas (the air) and by placing the stationary recorder in a current of gas the velocity of which is known. With the first method the absolute value of the temperature correction is obtained whereby the previously mentioned uncertain factors for determining the theoretical correction curve are eliminated. In the second case, on the other hand, only the recorder's deviation from the adiabatic correction curve is shown but against this the measuring devices required are not so complicated. Measurements have been carried out by Saab with a testing arrangement in accordance with the first alternative partly with single-wall "staudruck" thermometers and partly with double-wall insulating temperature recorders of the type shown in Figs. 1 and 2. Some representative results of the measurements obtained during these tests are indicated on the calculated adiabatic correction curve in Fig. 3. The testing arrangement (Fig. 4) consisted in principle of a centrifugal arm at the outer end of which the temperature recorder was located. The speed of rotation of the centrifugal arm was controlled by means of a 50 HP motor. Tests were also carried out with a temperature recorder so constructed that a vacuum was produced at the point of measurement, whilst at the same time the temperature was only reduced by 20 to 30 % and became dependent upon the height as described earlier.

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In tests with a temperature recorder located in the jet flowing from a compressed air container (Fig. 5) the discharge nozzle was so shaped that adiabatic expansion took place with subsequent cooling of the gas. At the slow down of the air in front of the recorder the air will be reheated, and at an adiabatic progress it would obtain the same temperature as the air in the container. The difference between the temperature in the container and in the recorder thereby indicates the deviation from the adiabatic correction curve. This deviation was found to be less than the measuring accuracy for speeds investigated up to 235 m/s, and preliminary tests carried out with an expanding nozzle for supersonic speeds have shown that the correction curve applies here also without any appreciable error. The values obtained with the two above-mentioned testing arrangements may be misleading however, if the recorder is not placed correctly during the actual measurement. Thus for example, no heat exchange must take place between the air to be measured and the surroundings prior to contact with the recorder. The effect of the location of the apparatus has not yet been studied sufficiently but is now being investigated. A recording equipment installed in an aircraft has however, been calibrated at ground level whereby both the ground temperature and the deflection of the recorder were measured at different flying speeds. Values were then obtained which, when corrected in accordance with the adiabatic correction curve, showed a measuring accuracy of $\pm 1°$ C for the temperature of the external air over the whole range of flight investigated.

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is carried out through pipes which project from the wing tips, that is to say, as far away from the engines as possible. In critical situations it must be possible to cut off the fuel supply to the engines quickly. For this purpose the fuel system, as well as the oil- and hydraulic systems, are fitted with electrically controlled shut-off-valves behind the fire-wall.

The demands with respect to safety have received the greatest attention throughout the engine installation. Means for preventing breakdowns in service are available to the widest conceivable extent, and should faults nevertheless occur, they can be rapidly localised and restricted thanks to the comprehensive safety system.

U. D. C. 629.138.6 Saab Safir

KRABBE, A: *Saab Safir — the gem of the air.* Saab Sonics no. 3 1948 p. 2—3.

Design of the Safir was begun in 1944 and it made its first flight in 1945. The plane is appreciated both by the Air Force and private owners. The Safir has aroused interest both inside and outside Europe. In the course of deliveries to Ethiopia a world record flight was made in 1947. South America and Asia are promising markets.

U. D. C. 373.63

WIDENGREN, A: *Technical education.* Saab Sonics no. 3 1948 p. 4—7.

High quality production calls for skilled workmanship. Saab's "assembly training school" forerunner of the technical training school. Task of the technical training school. Foremen are recruited from the training school to some extent. Duration of instruction and number of apprentices. Suitability test. Trial engagement. Training contract. Practical instruction takes first place. Theoretical instruction during three years. Number of hours of theory Advantages. Hourly wage while training. Bonus and "reward for diligence" Leisure-time occupation. Sports- and social club.

U. D. C. 536.5:551.524:629.13

SVENSSON, S: *Temperature measurements from aircraft.* Saab Sonics no. 3 1948 p. 9—11.

Tests at high flying speeds necessitate accurate recording of the temperature of the external air. Temperature recorders of small dimensions are required. Principles. Temperature rise on slowing down a mass of gas. "Staudruck"-principle. Temperature recorder developed by Saab. The adiabatic correction curve. Measuring equipment. A resistance wire is used as the measuring element in Saab's recorder. The temperature is measured by means of a crosscoil instrument. The temperature can be recorded by an oscillograph. Testing. Thermometer centrifugal arm and air container. The correction curve also applies to supersonic speeds. Values obtained when flying.

U. D. C. 623.593.3:623.558:621.398

REPORT: *A new Saab invention.* Saab Sonics no. 3 1948 p. 14—15.

Brief description of the hit indicator for targets towed by aircraft, a Saab invention.

U. D. C. 621.434:629.138.5 Saab Scandia

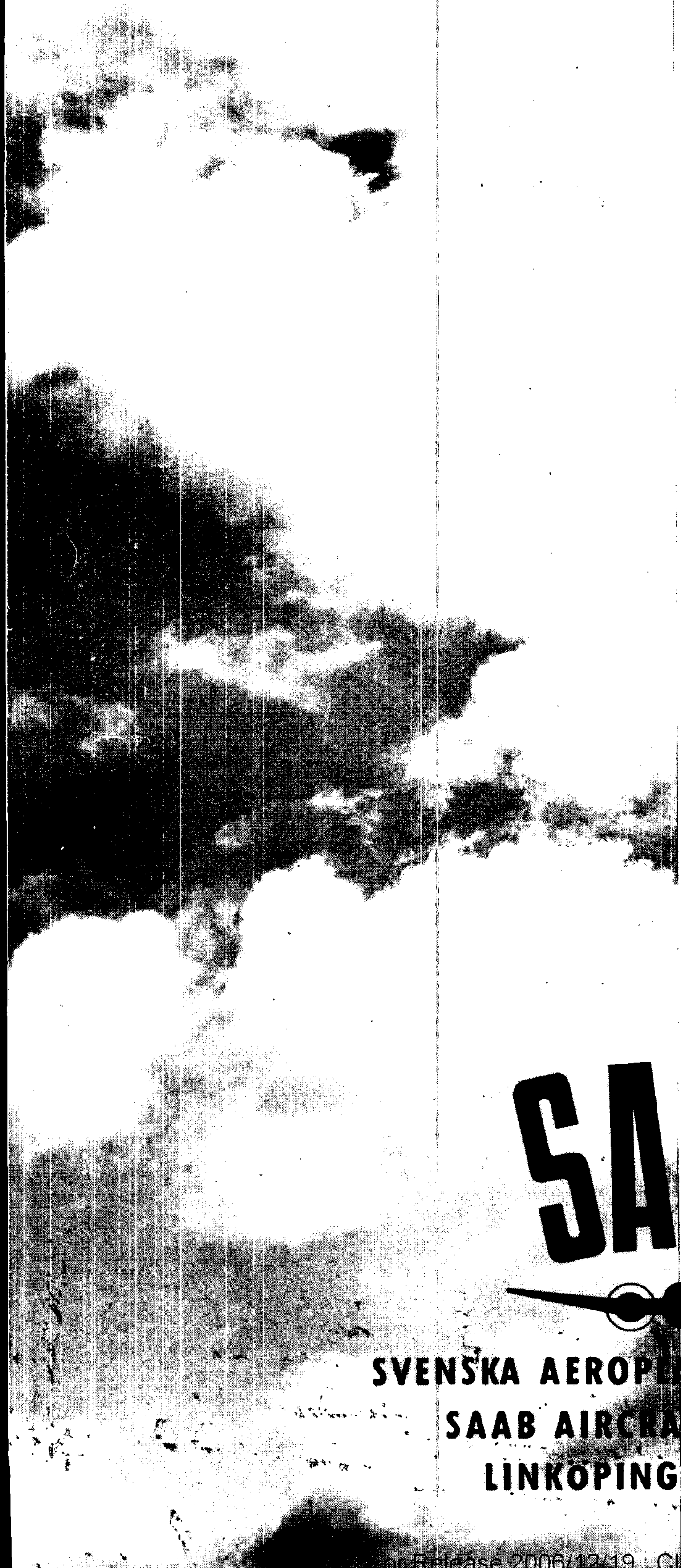
LAKOMAA, A: *The Scandia's engine installation.* Saab Sonics no. 3 1948 p. 16—19.

The engines are built by Pratt & Whitney and bear the type designations Twin Wasp 2 SD 13 GR-2000 and Twin Wasp R-2180. Much auxiliary apparatus is mounted directly on the engine. Hydraulic propeller reversal. Synchroscope for maintaining the same speed in both engines. Engine installation of the "Power egg" type. The power of the recoil in the exhaust gases is utilised. Double filtration of the carburettor's intake air. Comprehensive safety measures in the engine installation for the prevention of fire. Engine cowling constructed with two panels to facilitate inspection. The oil system forms part of the engine installation. Oil temperature regulated by thermostat. The engine fault detector records bearing faults. Fuel system located in the outer wings and nacelles. Tank pumps as a stand-by and auxiliary system. Rapid emptying through pipes in the wing tips.

U. D. C. 621.7.001.6+621.9.001.6:629.13

SVENSSON, A: *Technical development work in the Saab workshops.* Saab Sonics no. 3 1948 p. 20—24.

Technical research in the workshops of great importance in modern industry. Basic research and applied research. Development work particularly desirable in the aircraft industry. Manufacturing problems are solved as early as the projecting stage. Development work is separated from manufacture and concentrated in a technical service department. Development of working methods and tools. Manufacturing investigations. Technical advice on special manufacturing problems. Employment of "idea scouts". Suggestions from the workers are rewarded. Special applications of rubber pressing. Cold die-casting. Tool- and production grinding. Sub-zero treatment of high-speed steel tools. Diagrams of the different working operations are prepared. Testing and bending of tubes and extrusions.



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